# Quartz and Hydrated-Silica Bearing Terrain in Antoniadi Crater

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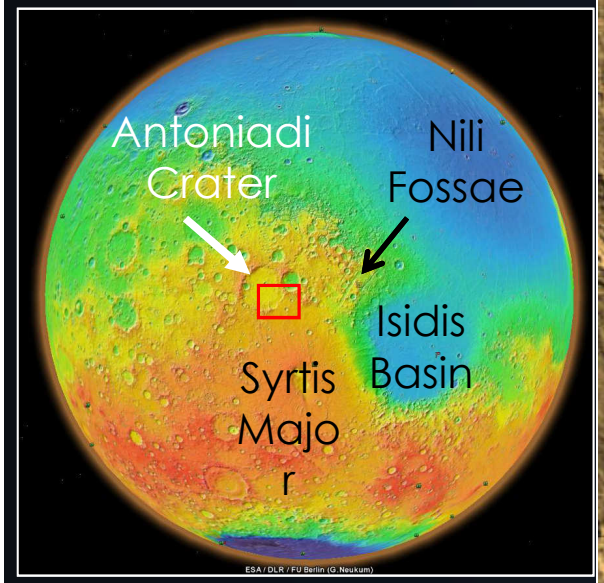
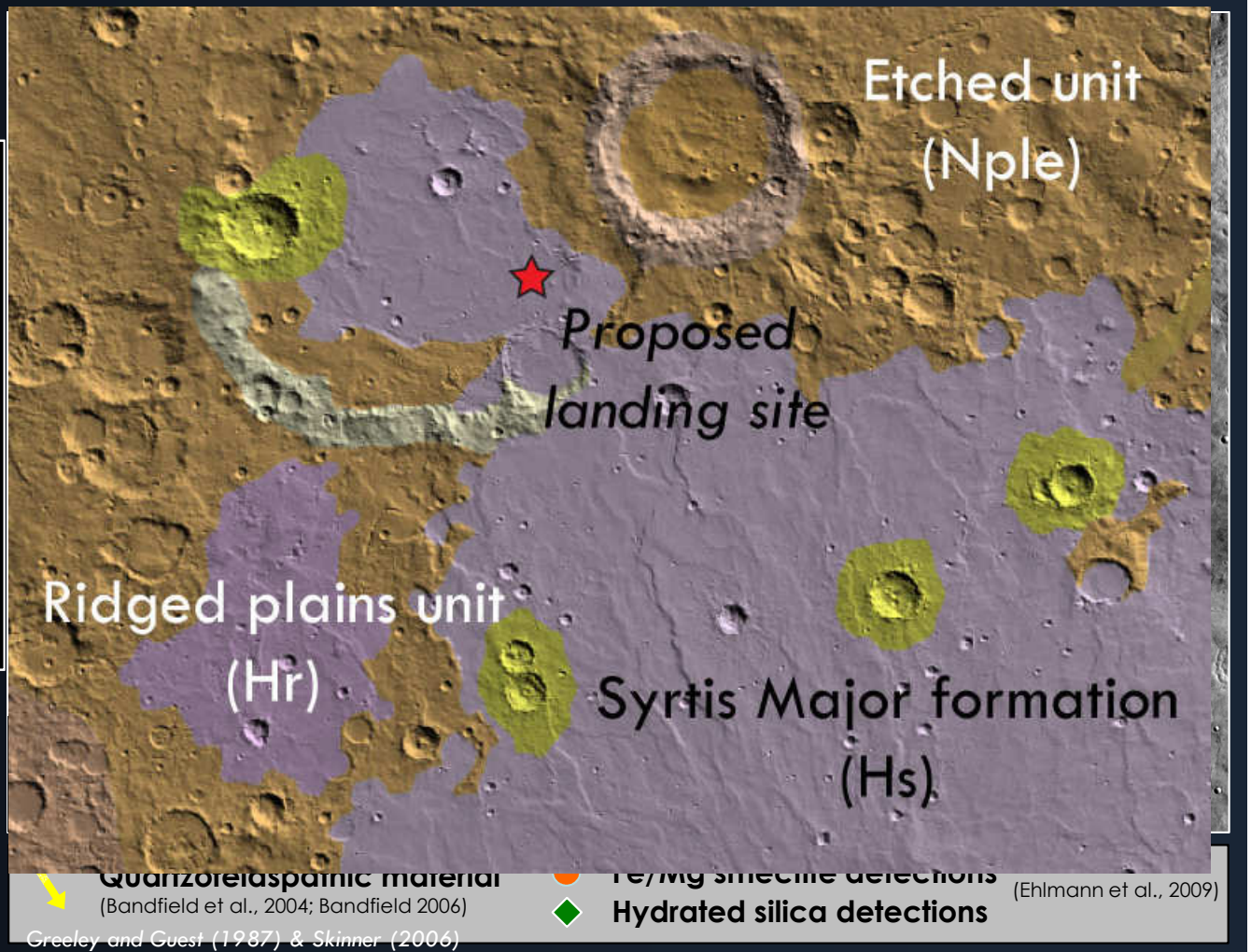
# Highlights of Antoniadi Crater Site

- Only identified quartz on the planet
  * Best preserved evidence of ancient life are in chert deposits
- All quartz is co-located with hydrated silica = aqueous formation mechanism
- Phyllosilicate-bearing Noachian breccia – greater mineral diversity and regional context

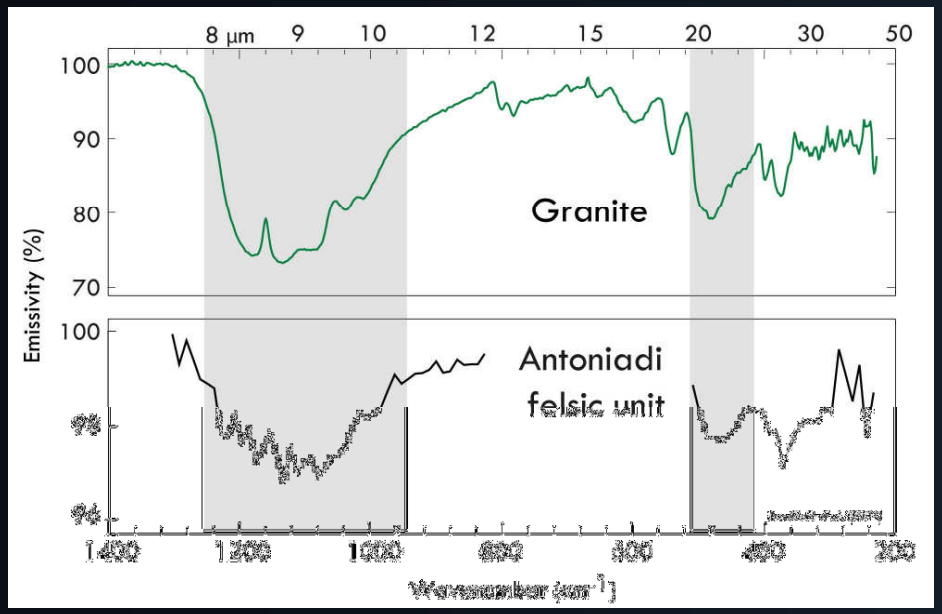
# Antoniadi Crater

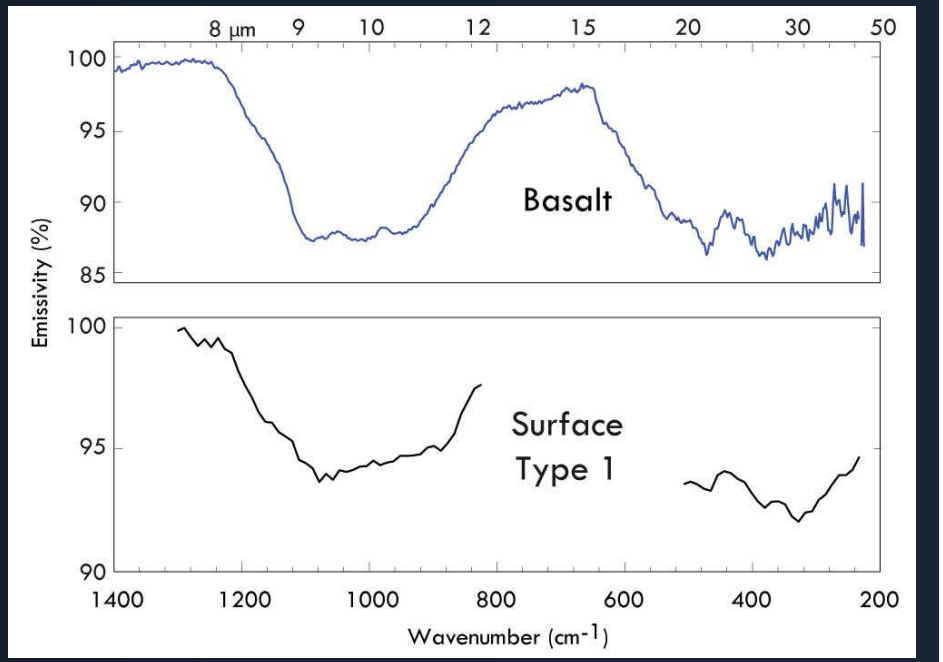



*Greeley and Guest (1987) & Skinner (2006)*

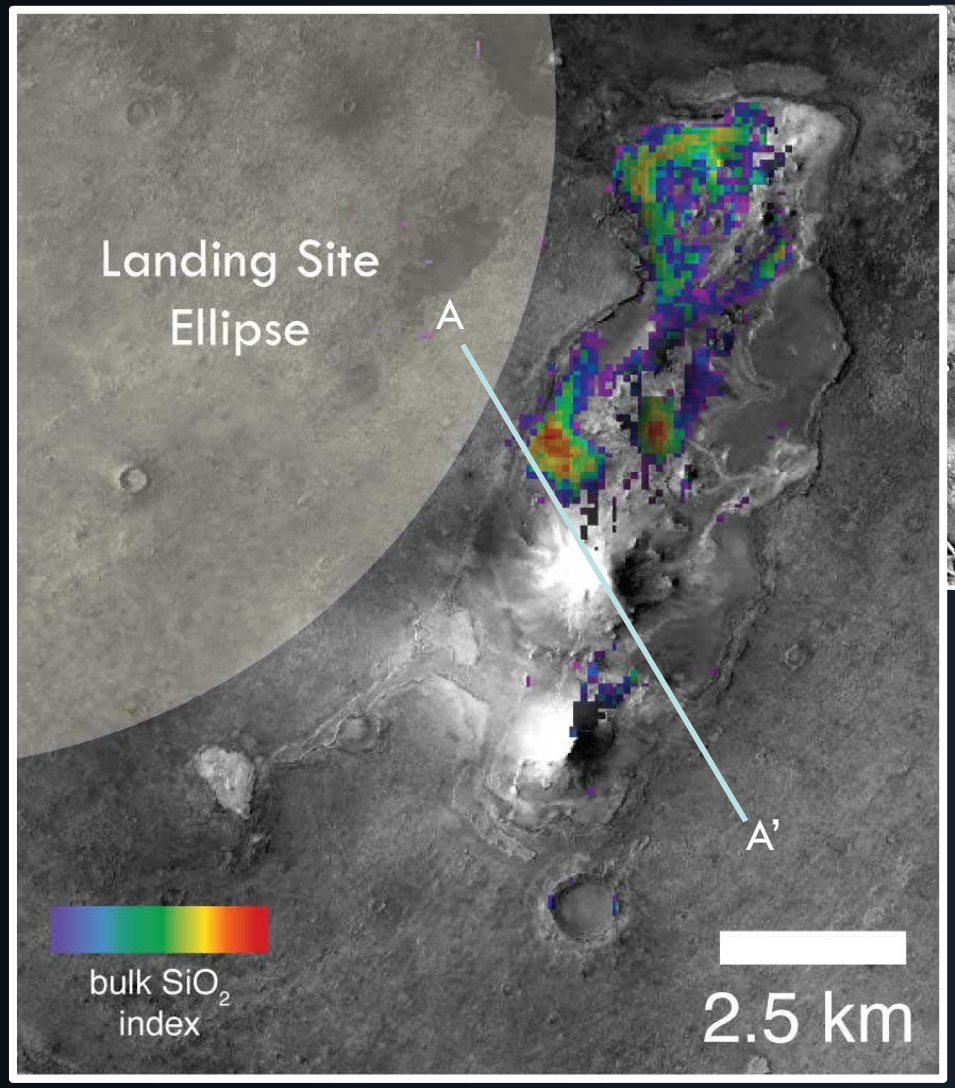
# Detecting the felsic signature

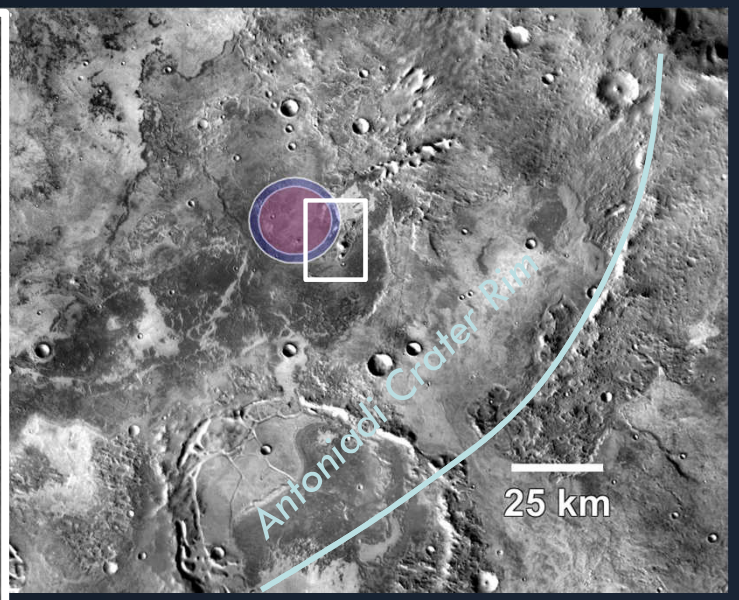


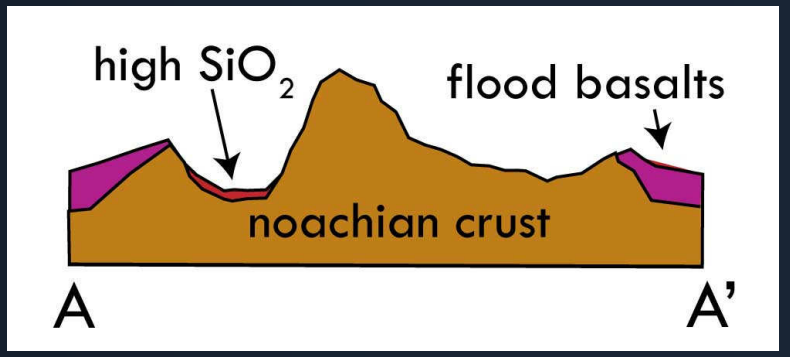




Short wavelength features shift to longer wavelengths for less silica-rich compositions

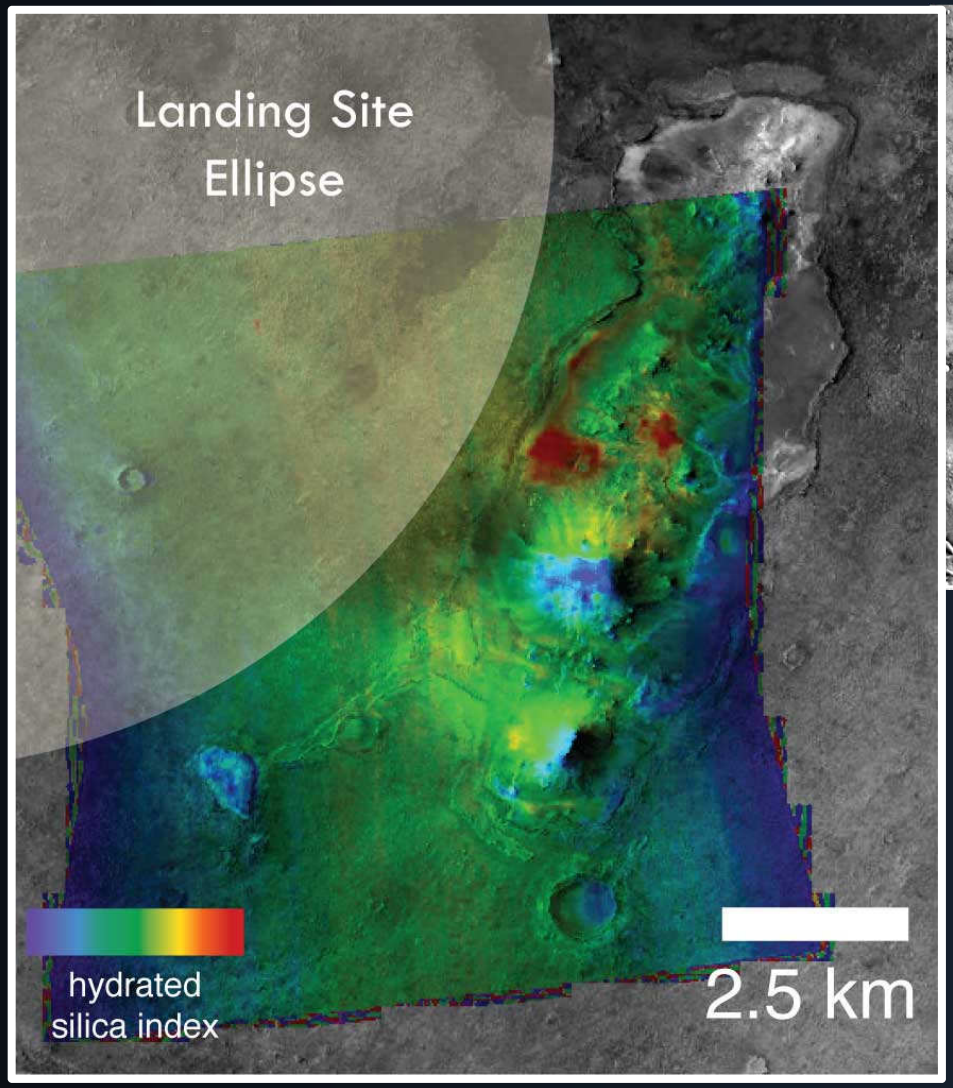
# Quartz-bearing units near landing site

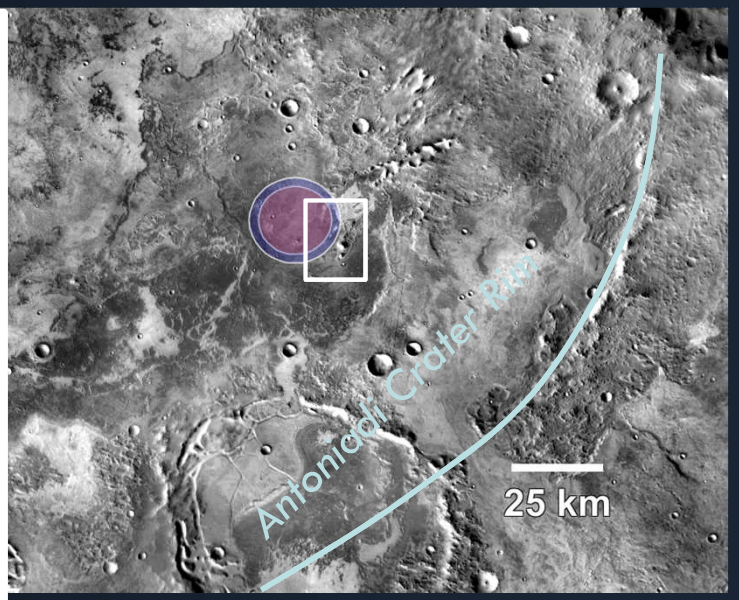


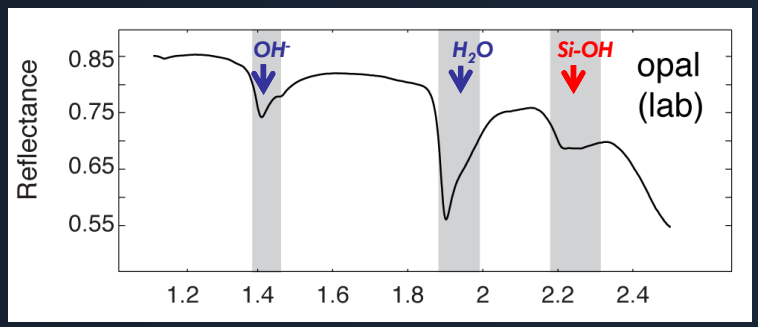



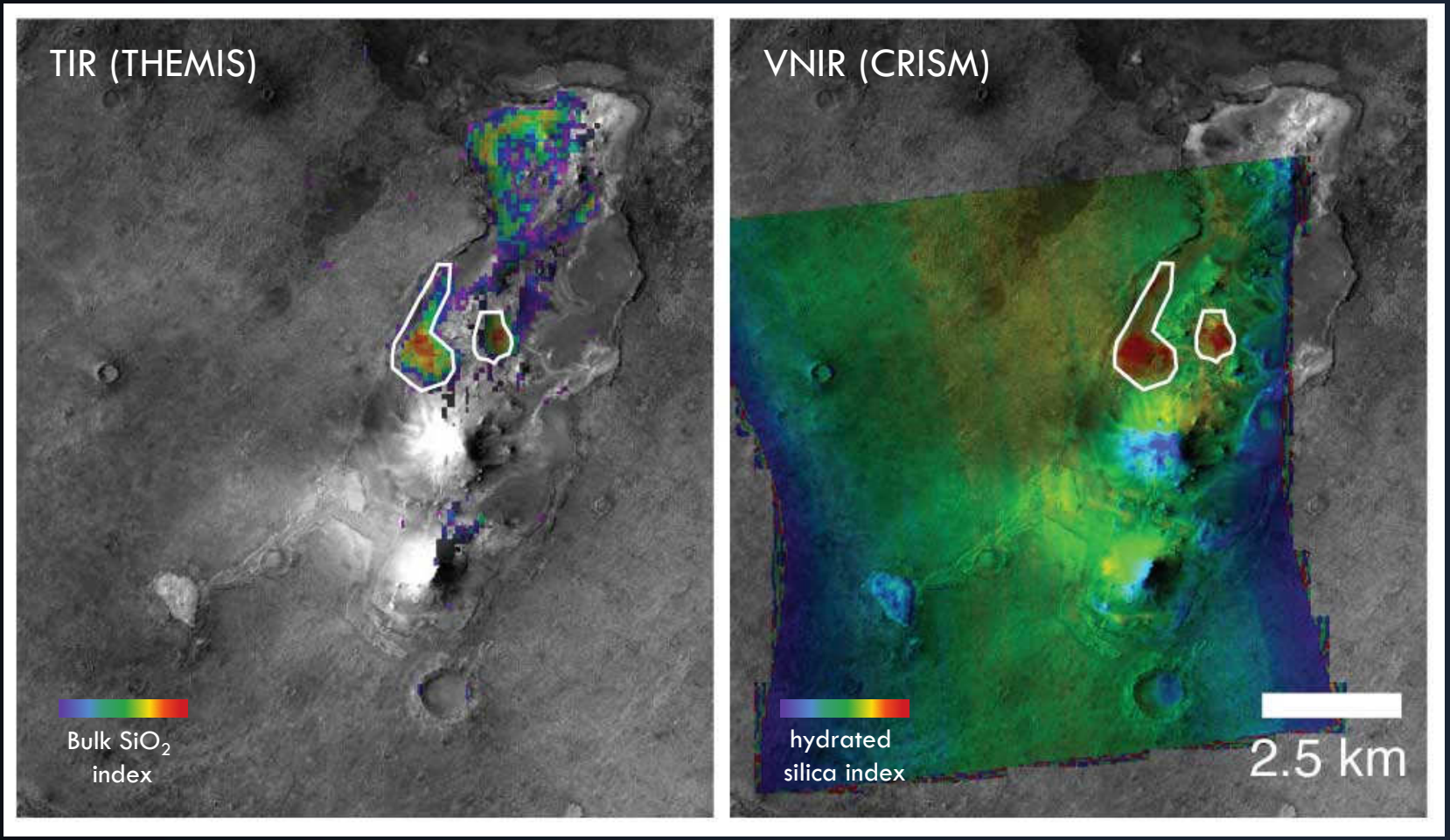
# Silica-bearing units near landing site



# Quartz and hydrated silica are in the same units!



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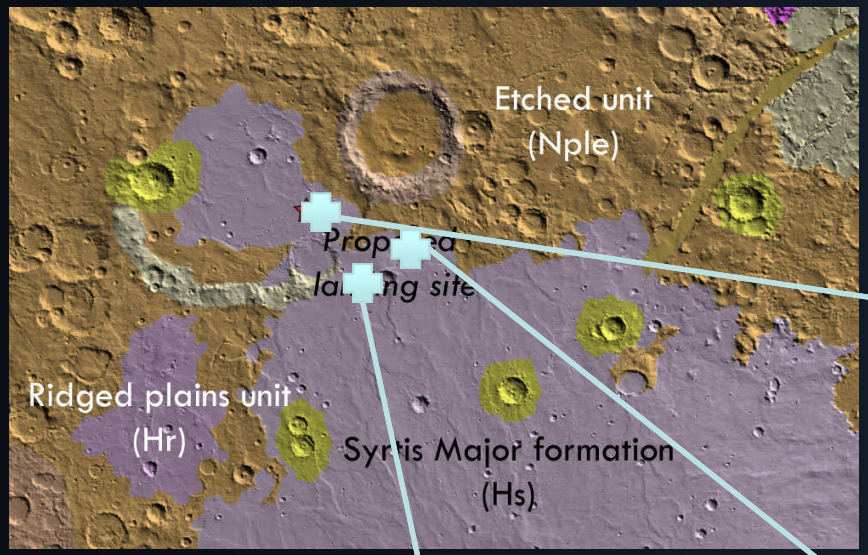
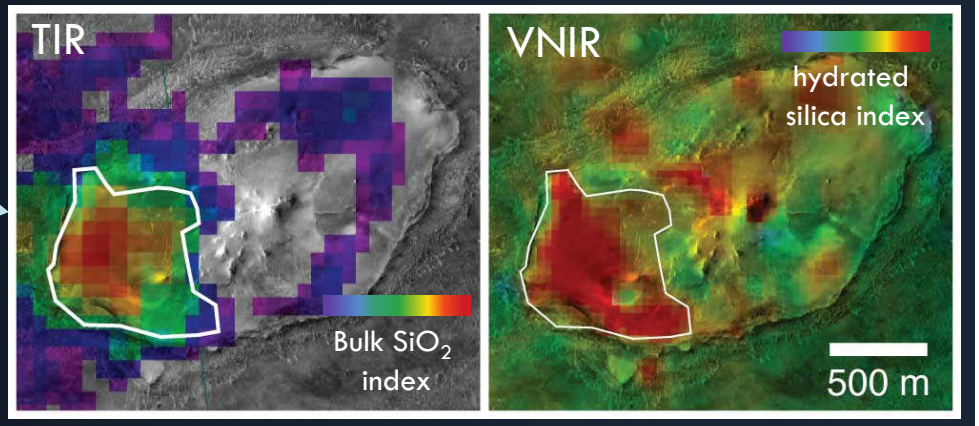
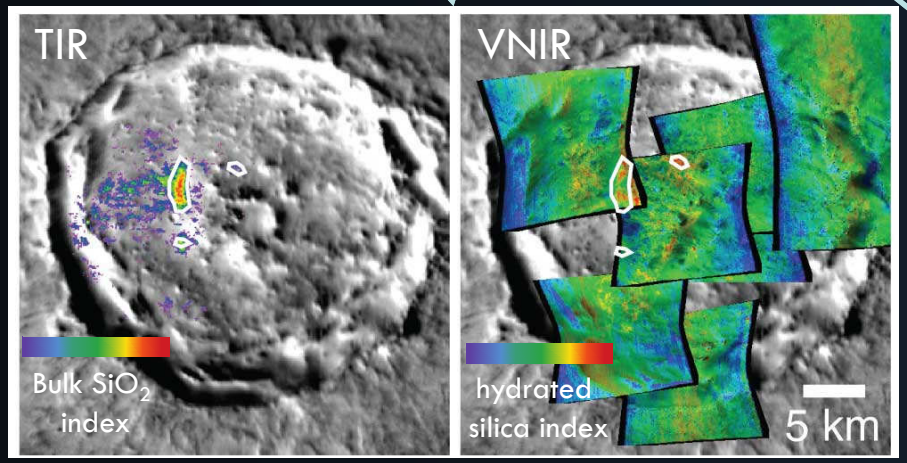
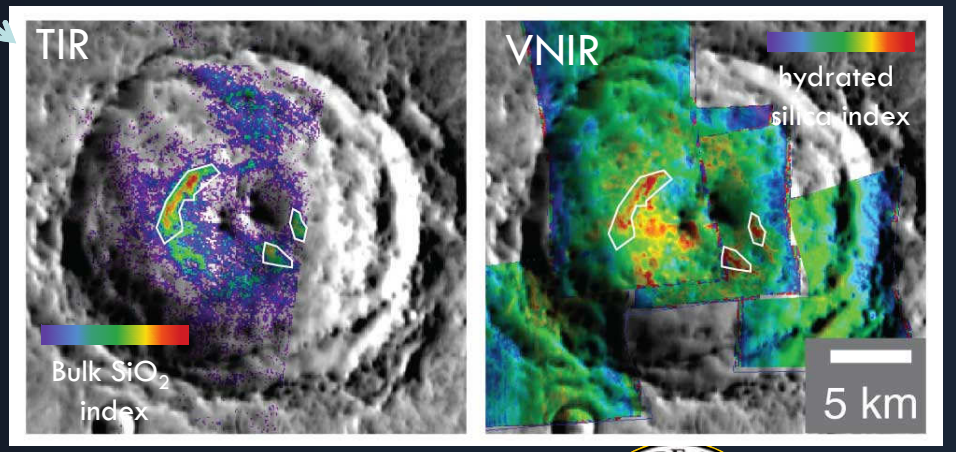
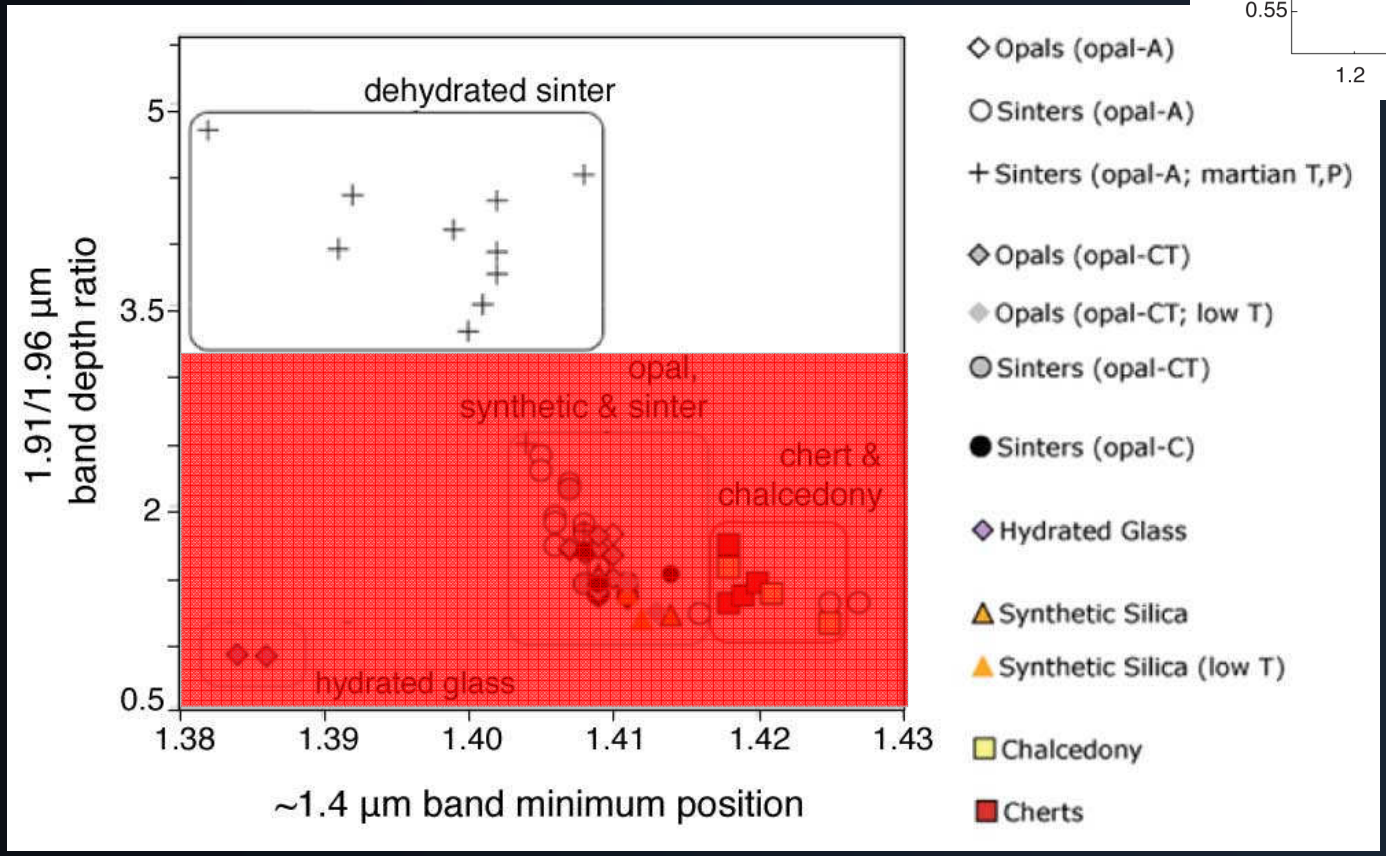


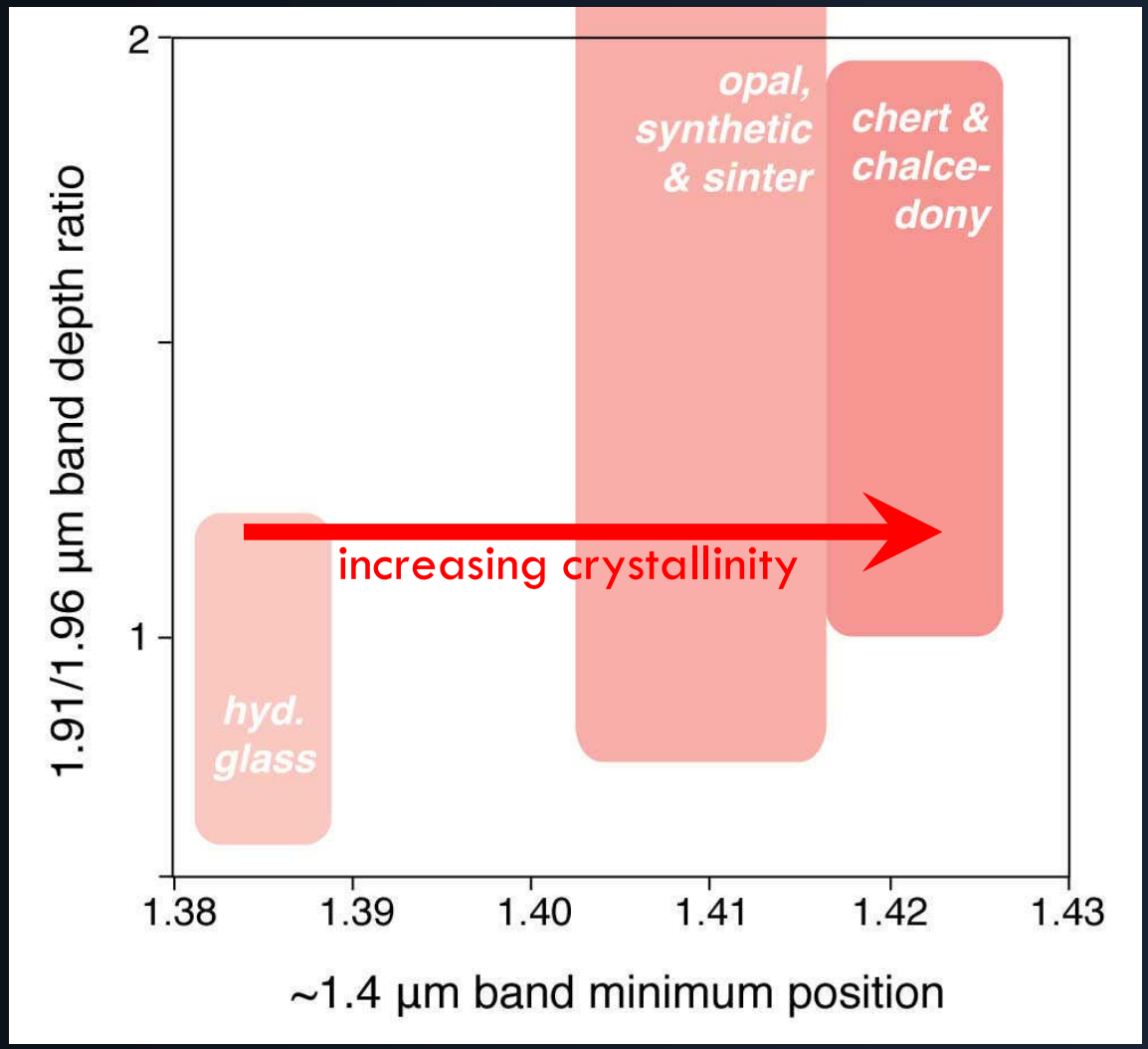



# Could the hydrated silica be crystalline?


*Rice et al., 2012, submitted*

# Silica comparison: How much alteration?




*modified from Rice et al., 2012, submitted*

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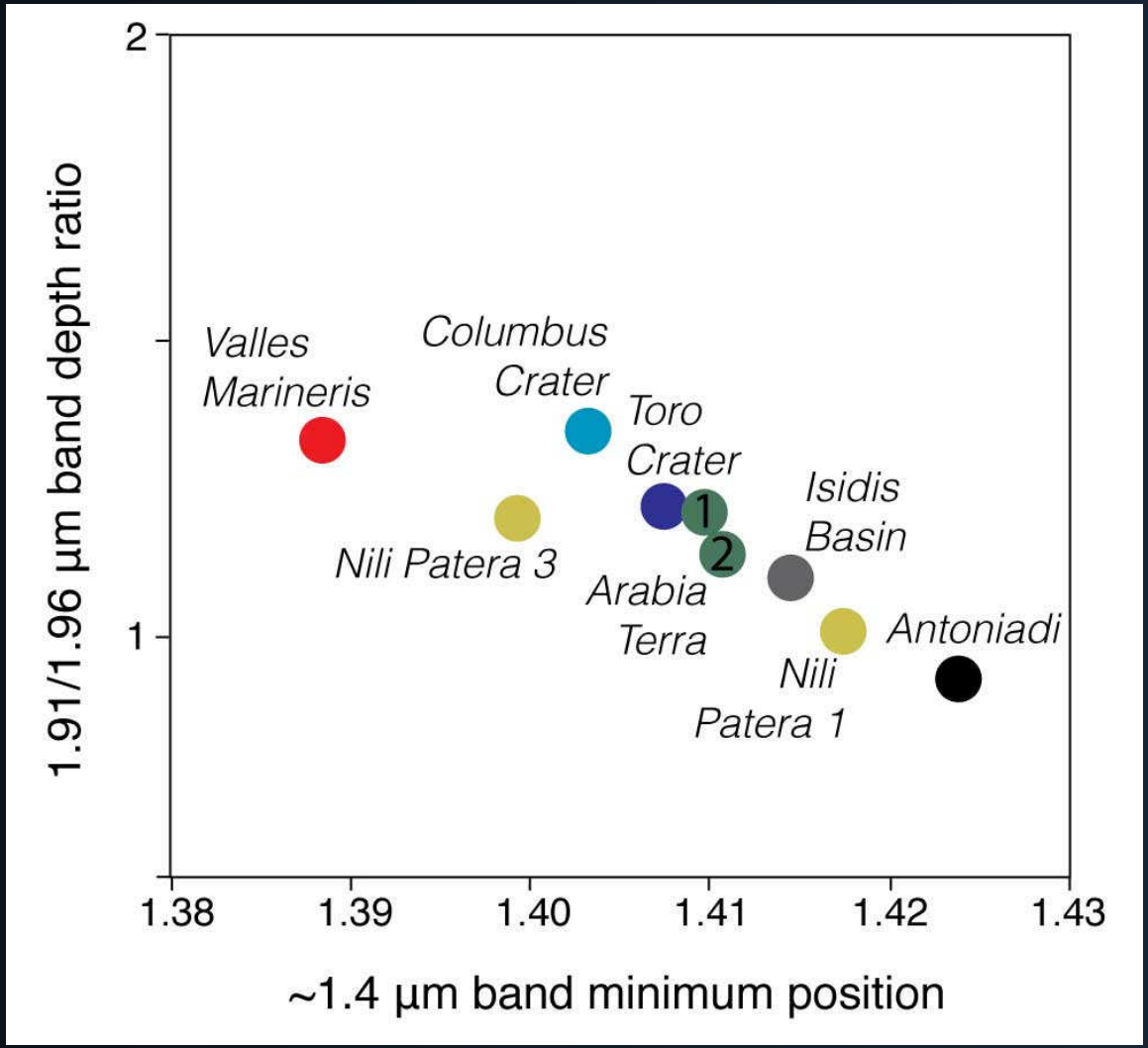
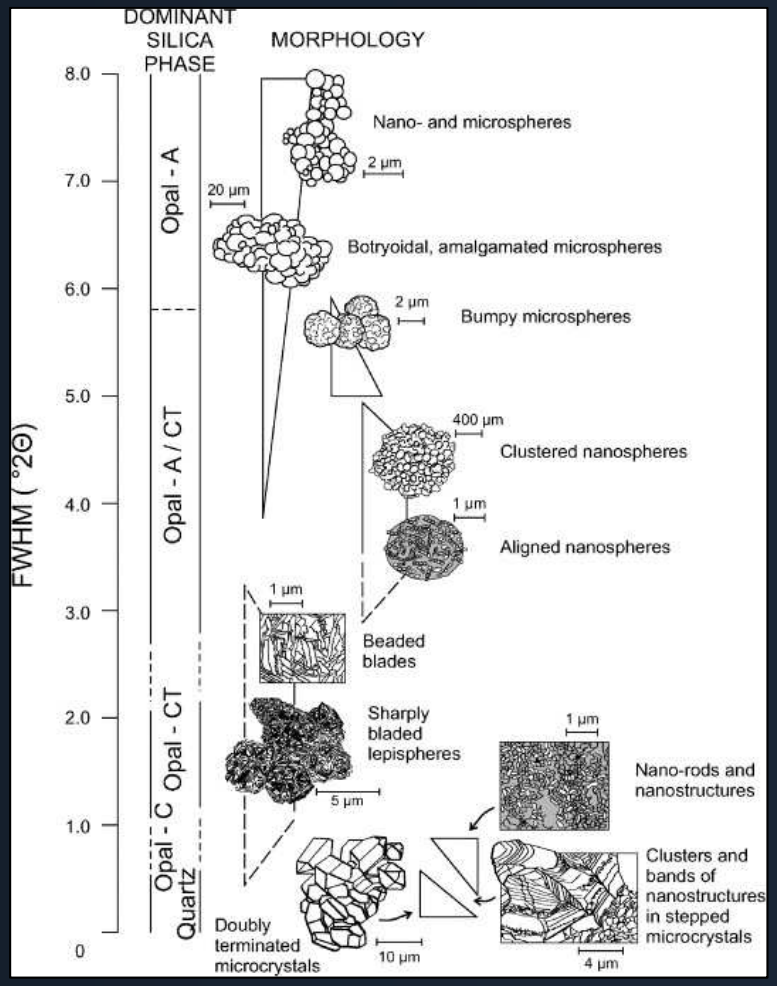


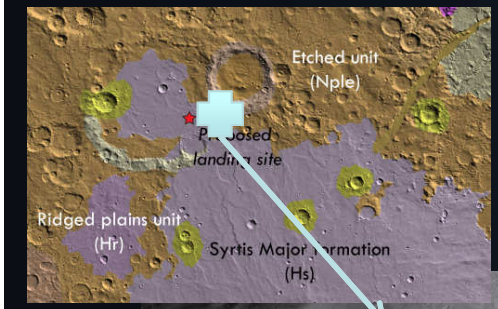
# A wet path to quartz

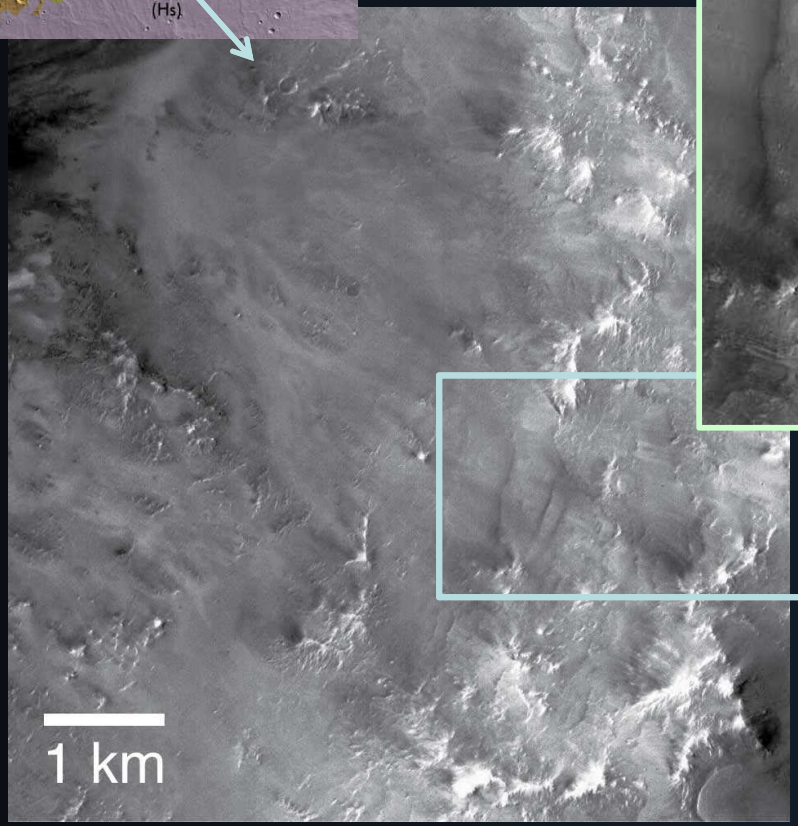
- Opal-A will alter to quartz in water
- Common diagenetic pathway for terrestrial chert deposits
- Alteration time is affected by heat, water chemistry & water availability
- Alteration can take between 1,000 (hydrothermal) – 400 million years (freezing) [*Tosca & Knoll,* 2009]

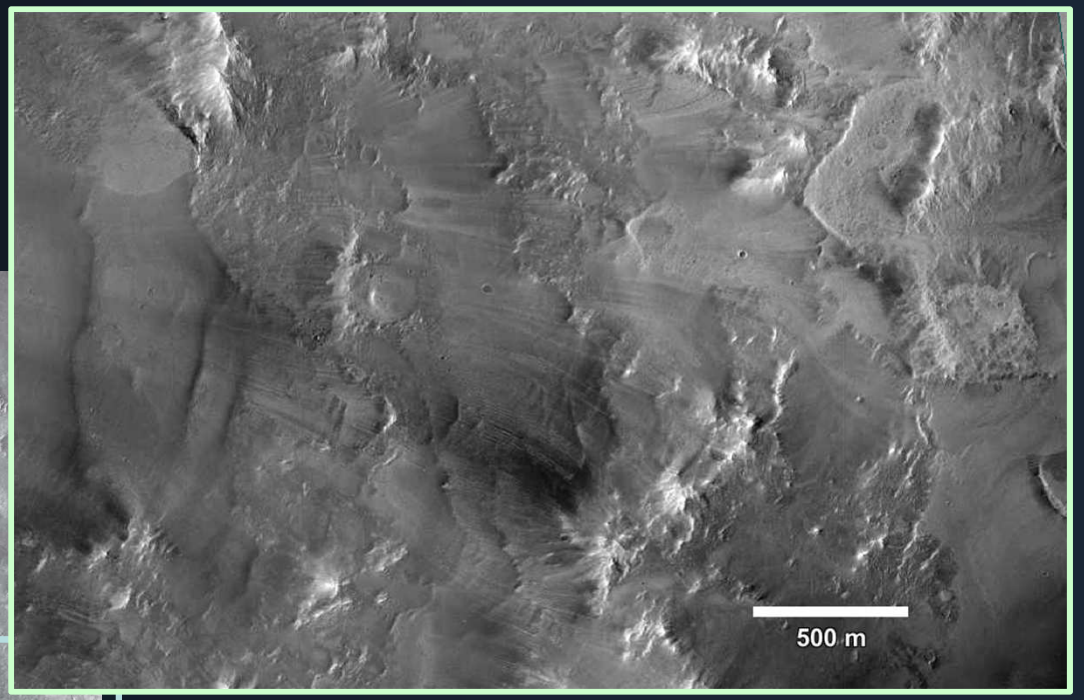



*Lynne et al.*, 2005

# Source of the silica



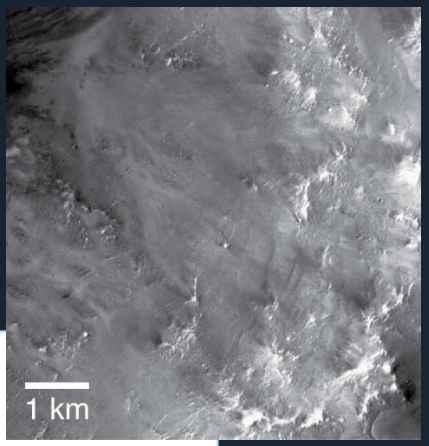



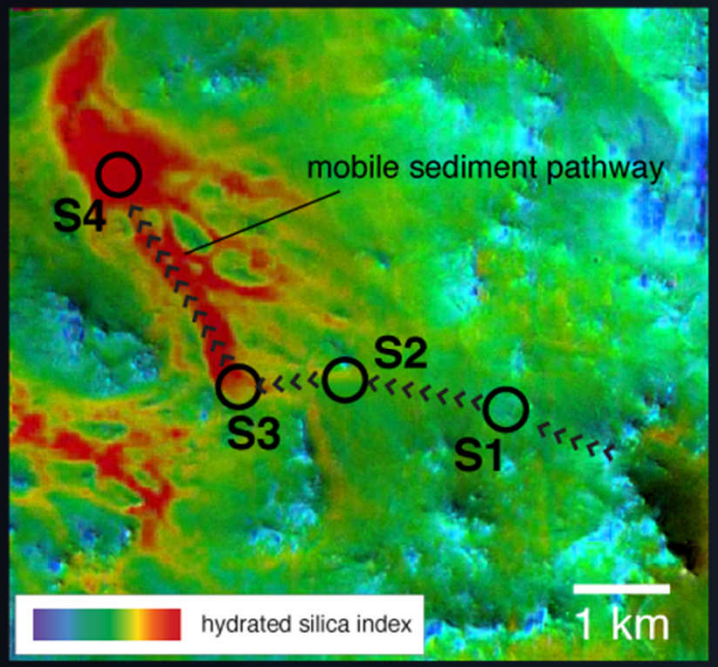



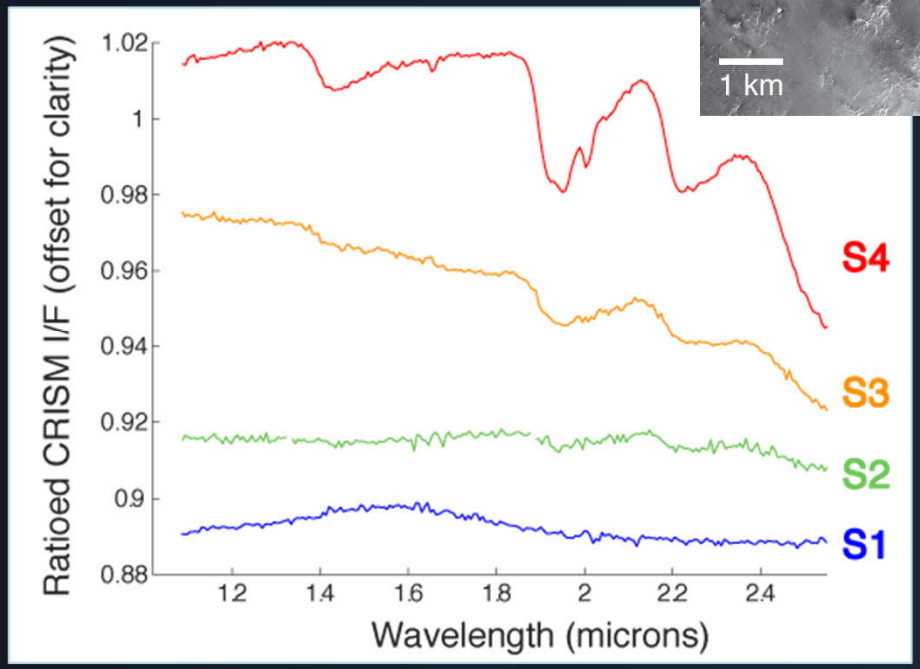

*Sediment is eroding and being transported downslope*

# Source of the silica

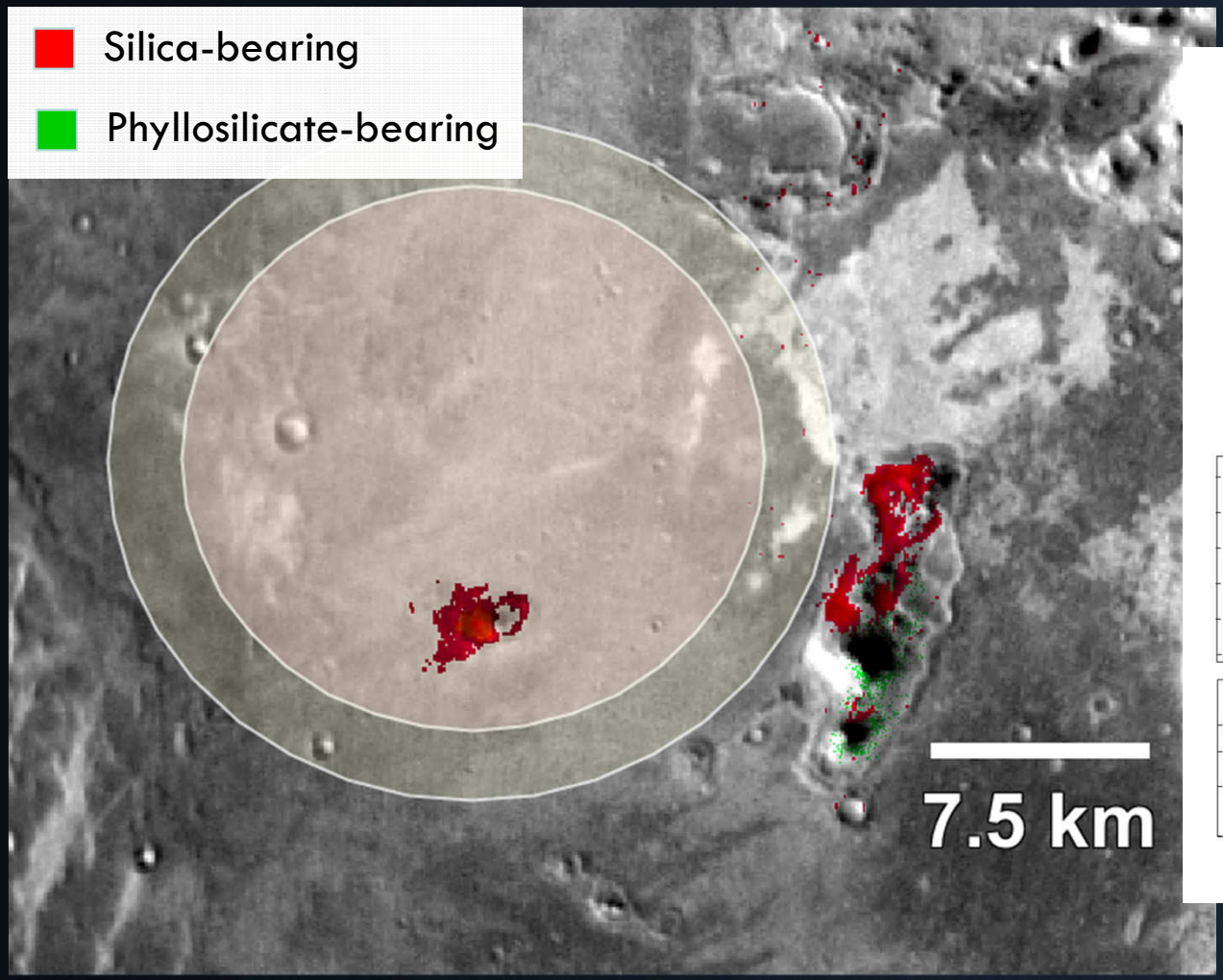
*Hydrated silica detections intensify as the sediment moves and accumulates downslope*

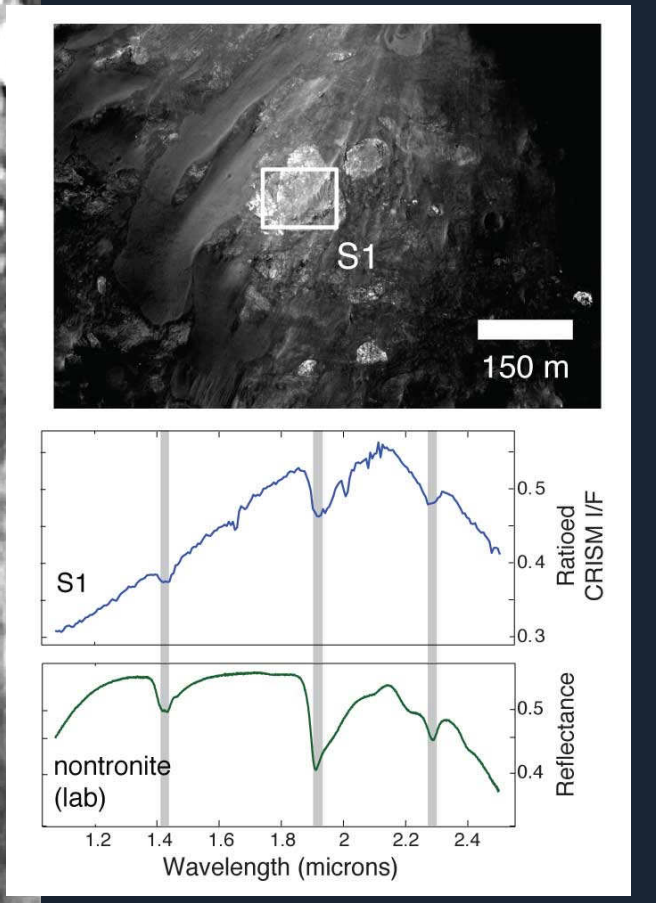


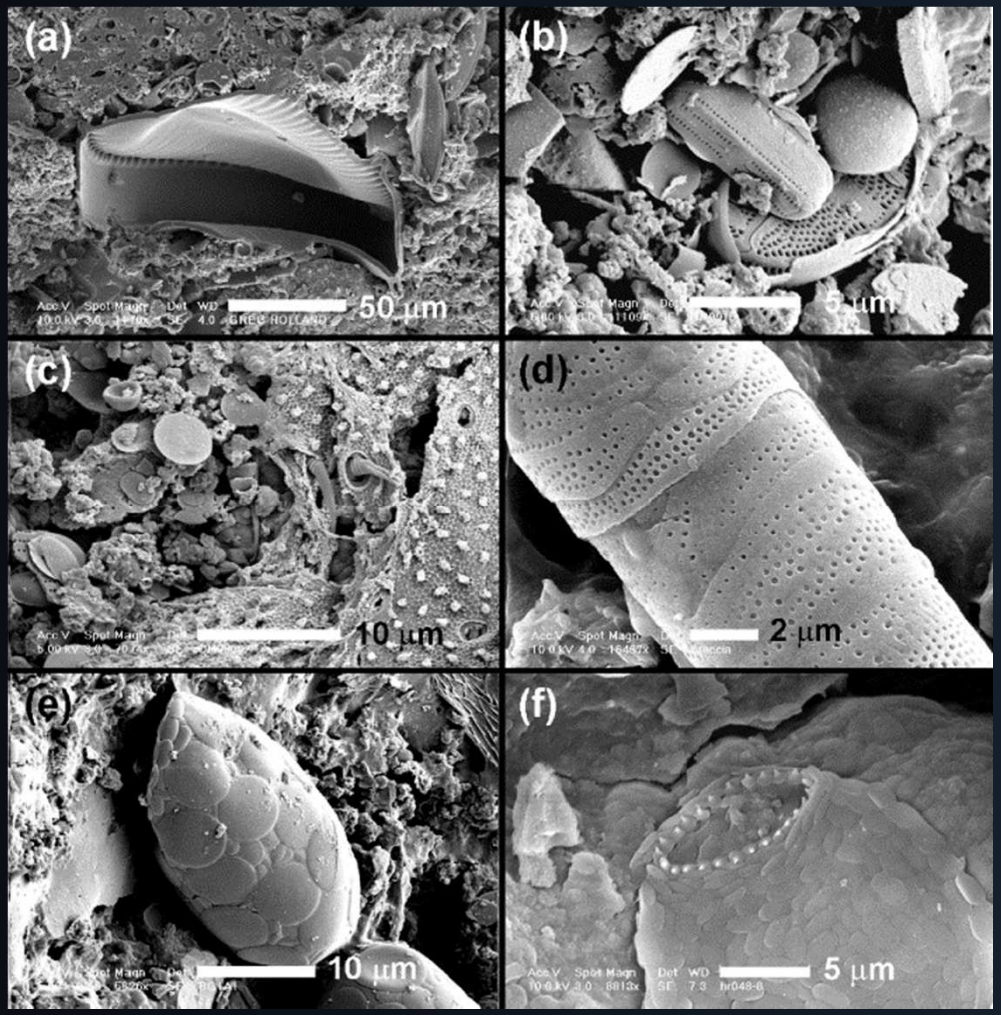



# Sites of interest near landing ellipse



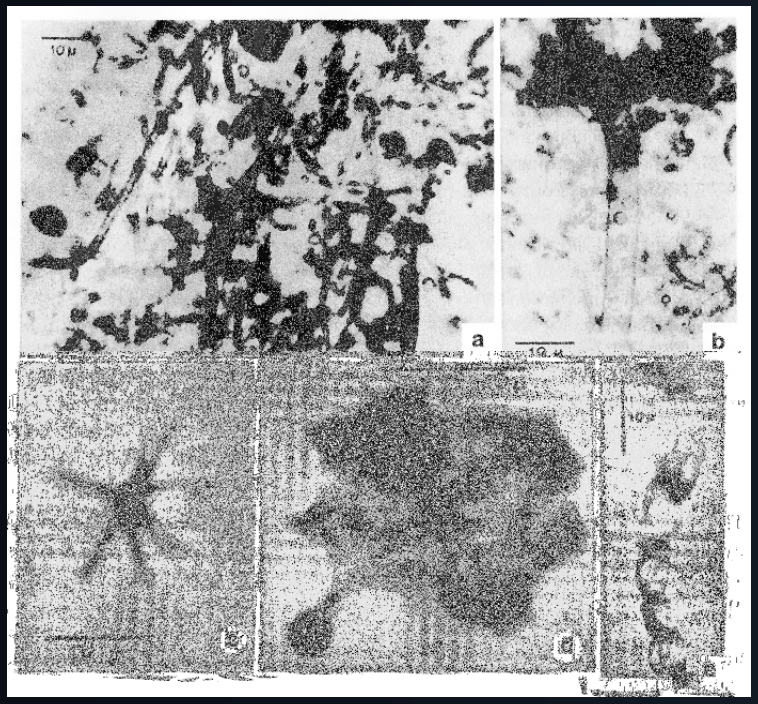
# Astrobiology: Making and trapping life




*Rodgers et al., 2004*

- Forms more easily in alkaline waters = good for early life
- The exceptionally high degree of crystallinity here suggests more water/heat to allow for life to gain a foothold
- Silica precipitates quickly and can quickly entomb microfossils

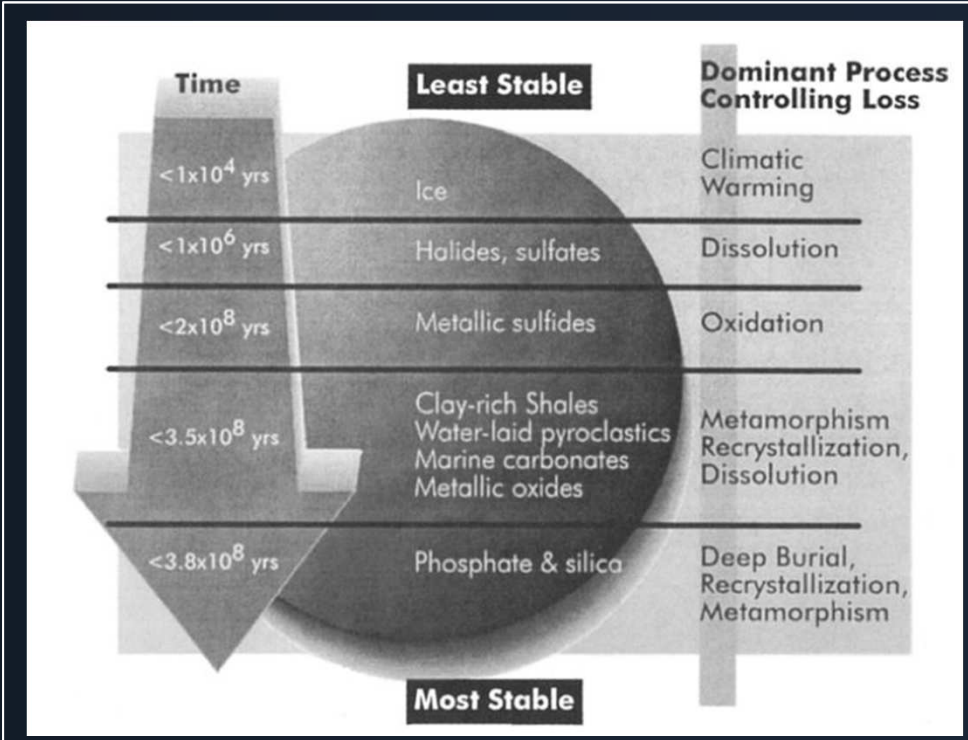
# Astrobiology: Preserving the evidence



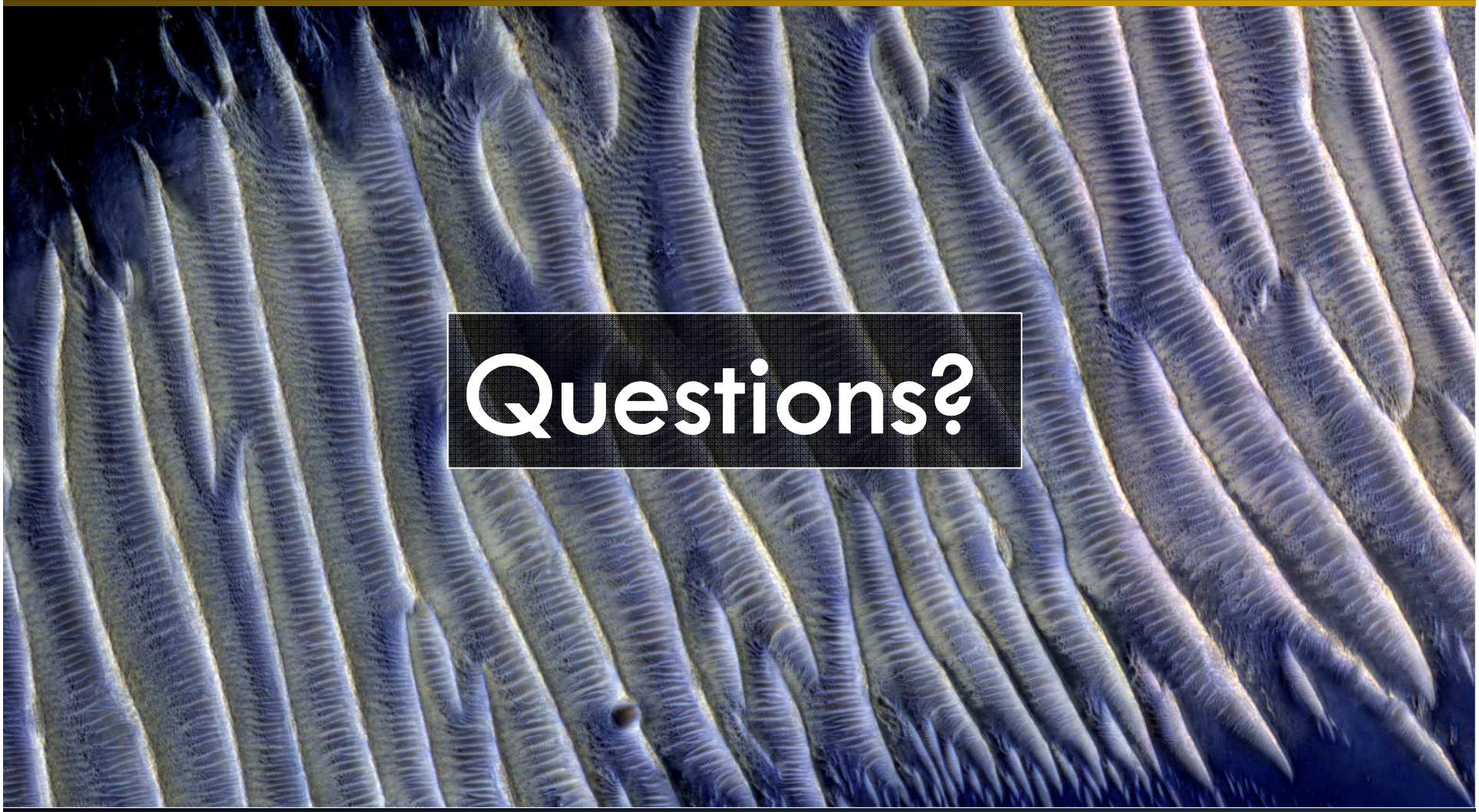

*Well-preserved microfossils from the 1.9 Ga Gunflint Chert, Ontario* [Barghoorn and Tyler, 1965]

Best-preserved evidence of ancient microbes are found in proterozoic cherts

Silica is chemically stable over geologic timescales



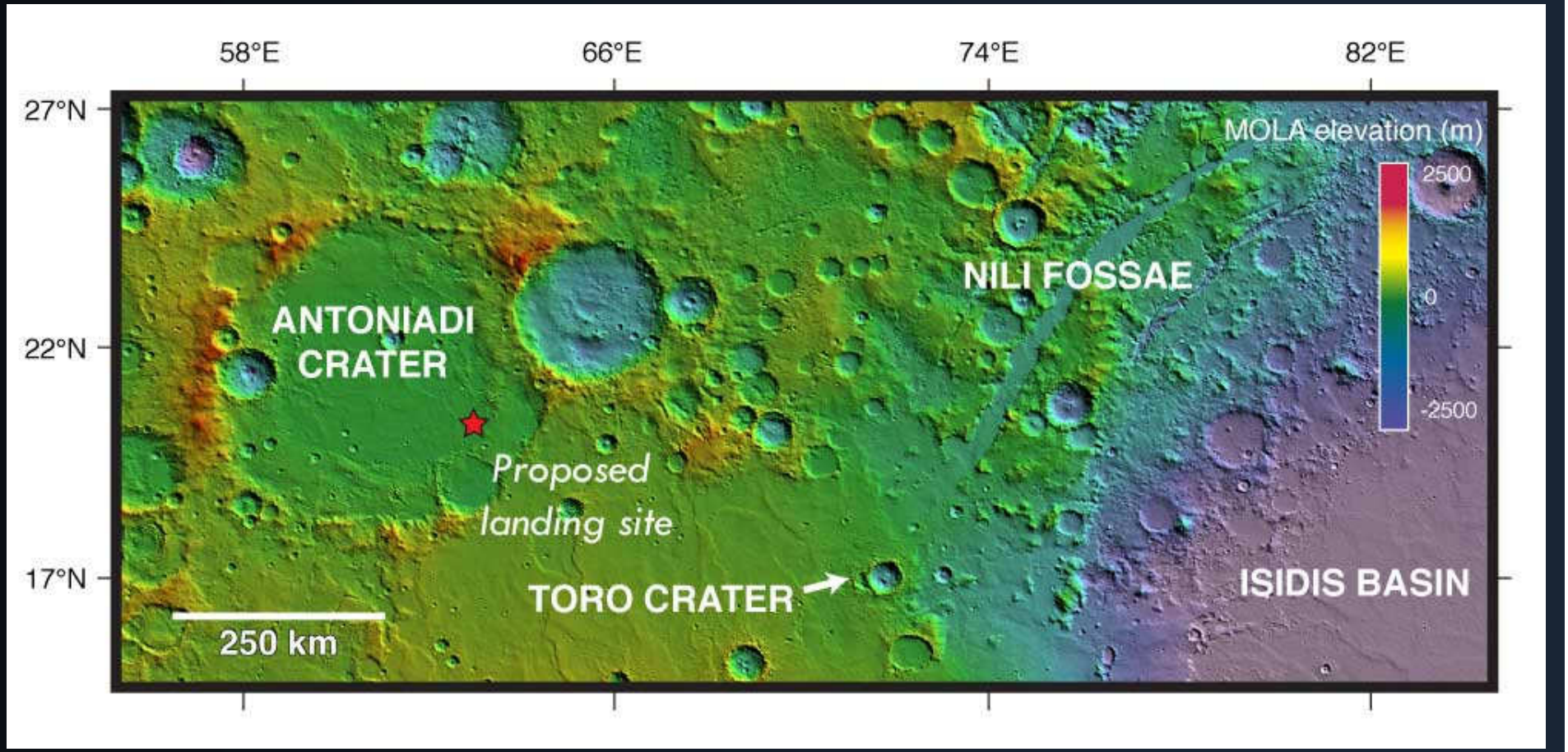

*Farmer and Des Marais, 1999*


Questions?

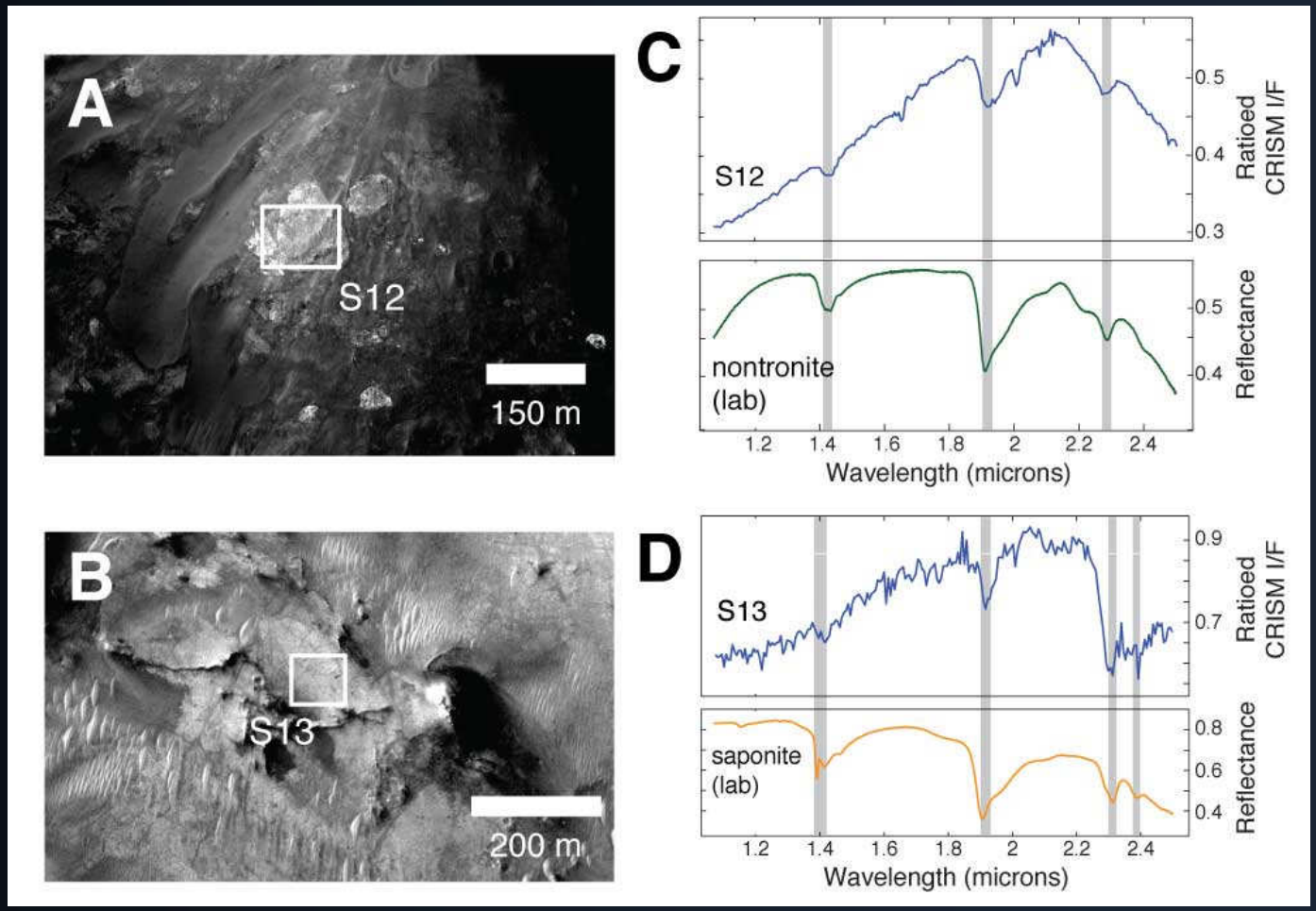
# Landing ellipse parameters

- Accessibility to targets
  - Nearest Target: 0 km
  - Ultimate Target: 13 km (from center of ellipse)
- Dust cover index: 0.97
- Latitude, Longitude: 20.568N, 62.8122E
- Rock abundance: 15.7% blocks *[IRTM]*
- Thermal inertia: 316 *[TES]*
- Albedo: 0.18 *[IRTM + TES]*
- Mean Elevation: 113.2 m

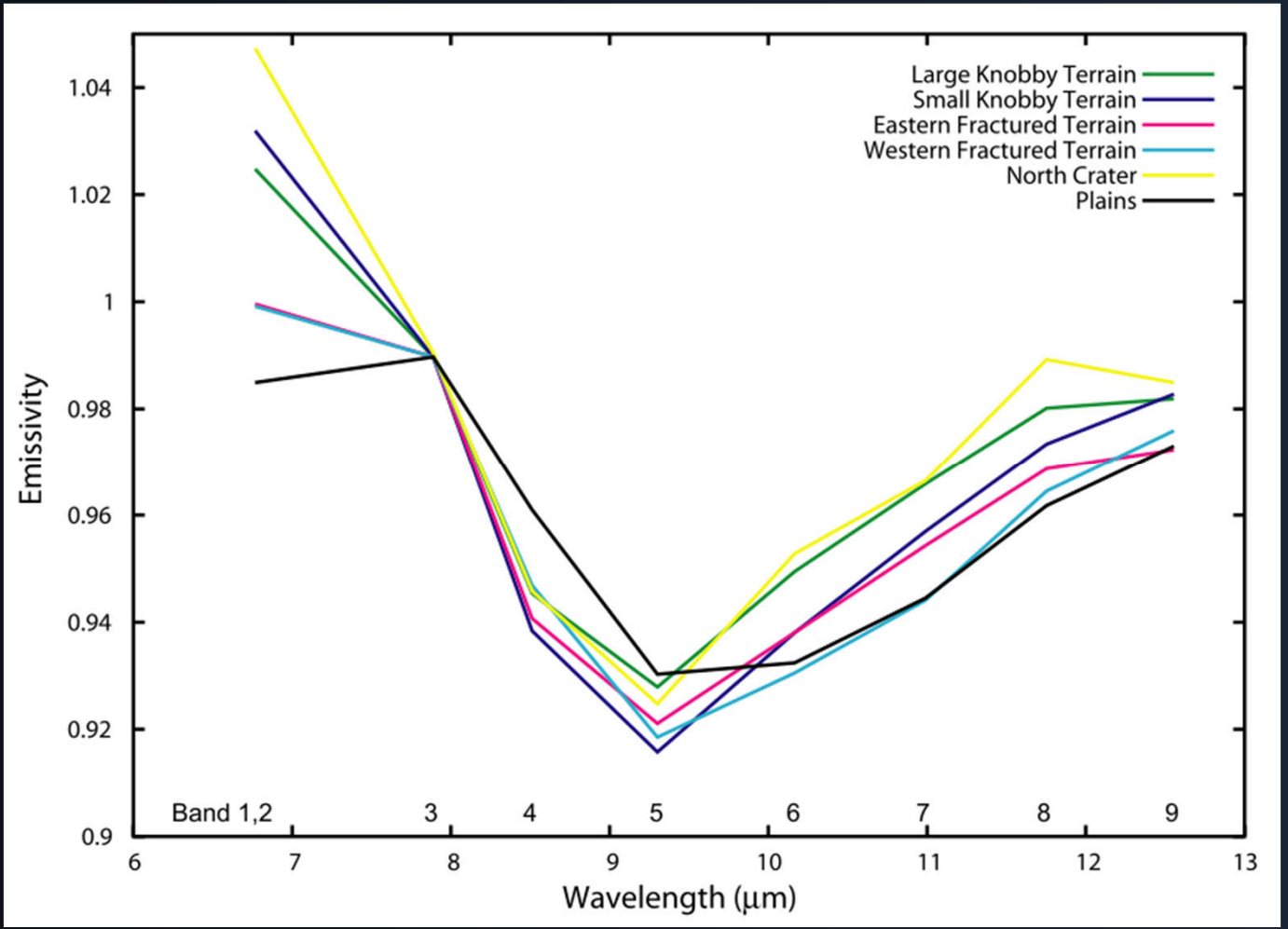
# Regional context



# Noachian phyllosilicates



# THEMIS spectra of QF units



# How can quartz form?

- *Primary igneous mineral*
- *Aqueous precipitate*
  - *Diagenetic alteration of opaline silica*
  - *Primary (veins/vugs)*